Public preferences for multiple dimensions of bird biodiversity at the coast: insights for the cultural ecosystem services framework

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Highlights

We used a choice experiment to value four different measures of avifauna biodiversity

Respondents valued species richness, abundance, rare species and wildlife spectacles

Latent class analysis found considerable heterogeneity in preferences

Ecosystem management must consider multiple measures of biodiversity

Public preferences for multiple dimensions of bird biodiversity at the coast: insights for the cultural ecosystem services framework.

Keywords: coastal management, coastal zones, discrete choice experiments, ecosystem services, willingness to pay, valuation.

Abstract

Biodiversity is valuable to society, including through its contribution to cultural benefits: "the non-material benefits people obtain from biodiversity and ecosystem services through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences". Biodiversity encompasses numerous measures, but the distinct values of these measures have been little studied. We conducted a discrete choice experiment to elicit respondents' (n=3,000) willingness to pay for increases in four measures of bird diversity in UK coastal ecosystems: number of bird species (species richness), number of individual birds (abundance), probability of seeing rare or unusual bird species, and probability of seeing large flocks of birds (wildlife spectacles). Respondents had a positive willingness to pay (through one-time voluntary donations) for increases in all four measures (mean £3 to £5 per household). However, using latent class analysis we found considerable heterogeneity of preferences, identifying four classes of respondents with strikingly different levels of marginal willingness to pay for the four measures. Income, age, environmental activity, visits to environmental settings, and gender were important determinants of class membership. While focusing on birds, our results demonstrate the importance of a multi-dimensional conceptualisation of biodiversity in broader ecosystem management, rather than focussing on a single aspect such as species richness or abundance. Our findings also highlight the implications of heterogeneous public preferences for biodiversity for conservationists, planners, shoreline managers and developers. These need to be considered in the development of new frameworks for ecosystem services, and when planning and funding conservation actions so that the cultural benefits will accrue across a range of social groups.

1. Introduction

Biodiversity provides many benefits to humans, including cultural benefits: "the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (MEA 2005; see also, TEEB, 2010; Satterfield *et al.* 2013; Fish *et.al.* 2016; Oleson *et al.*2016; EEA, 2018). In addition to the cultural importance of biodiversity, broader links have been hypothesised between biodiversity and human wellbeing (Dallimer *et al.* 2012; Clark, 2014), with benefits ranging from psychological restoration (e.g. Kaplan, 1995) and improved physiological health (e.g. Hanski *et al.* 2012), to better social relations (e.g. Weinstein *et al.* 2015). However, little is understood about the significance of different measures of biodiversity, e.g. the number of

species (richness), the number of individuals, number of rare species, or behaviour for example such as birdsong or wildlife spectacles caused by birds flocking together (Börger *et al*. 2014; Dallimer *et al*. 2014; Faccioli *et al*. 2015). It is therefore largely unknown how different forms of biodiversity change will affect human well-being and welfare (e.g. Keniger *et al*. 2013, Lovell *et al*. 2014, Cracknell *et al*. 2015). Looking at coastal bird communities, Luisetti *et al*. (2011) report that marginal willingness to pay for species richness, declines above four bird species, but such studies are rare. Key determinants behind social preferences are also poorly understood (Sali *et al*. 2008). A range of social factors such as income, gender, age, and environmental attitudes may combine with cultural variations in how biodiversity is perceived and valued (Ressurreição *et al*. 2012).

Birds are appreciated by many people undertaking outdoor activities or in their social settings. However, birding more specifically is also a deliberately undertaken activity which takes diverse forms: from short excursions during other activities to enjoy the sights, sounds and behaviour of birds; to trips to nature reserves or other areas, using equipment such as binoculars and infrastructure such as bird hides; to 'twitching' (UK) or 'catching' (US) which involves dedicated trips to see rare birds (Connell, 2009). The significance of species diversity as a factor across a large proportion of avitourism strategies has been highlighted (Steven *et al*. 2017). Coastal ecosystems support large numbers of waterbirds and the UK is of global importance for these species due to its location on migratory flyways, and extensive, productive estuarine mudflat and saltmarsh habitats (Frost *et al*. 2019a, b; Stroud *et al*. 2001). Many of these wetland sites are classified as Special Protection Areas (SPAs), in accordance with the EC 'Birds Directive' (2009/147/EC), as part of the Natura 2000 network, or as Wetlands of International Importance under the Ramsar Convention, to provide protection to the bird populations that they support, especially overwintering species. The selection criteria for SPAs focus on the numbers of individual species or overall assemblage of birds that regularly occur on a site (Stroud *et al*. 2016). The Wetland Bird Survey (WeBS) monitors the populations of non-breeding waterbirds in the UK, providing data on the numbers and trends of waterbirds occurring at site and national levels (Frost *et al*. 2019a). These data inform the selection of conservation sites and also track the conservation status of feature species of these sites (Cook *et al*. 2013). While numbers of several waterbird species have declined in the UK in recent decades (Brown *et al*. 2015, Frost *et al*. 2016), there has been a general increase in the numbers of species (i.e. species richness) and functional diversity (an index that measures trait dispersion) of waterbird communities occurring on estuarine and coastal sites since the 1980s (Mendez *et al*. 2012). An important driver of these changes is climate change, which has been linked with shifts in species' wintering distributions towards continental Europe (Austin & Rehfisch 2005, Maclean *et al*. 2008; Johnston *et al*. 2013) and impacts on populations on their Arctic breeding grounds (Rehfisch & Crick 2003; Robinson *et al*. 2009). Shellfishing (van Gils *et al*. 2006; Atkinson *et al*. 2010), increased disturbance (Stillman *et al*. 2007), loss of habitat due to sea-level rise (Durrell *et al*. 2006; Iwamura *et al*. 2013) or coastal development (Burton *et al*. 2006; Goss-Custard *et al*. 2006) may also contribute to site-specific changes.

Using avian biodiversity in UK coastal ecosystems as a case study, this paper aims to provide a deeper understanding of what is important about biodiversity and to whom. There are multiple trade-offs between different services – for example, whether coastal space should be prioritised for production, conservation or cultural services such as recreation, and what

combination of services are possible (Bradbury *et al*. 2010; Fisher *et al*. 2011; Ruijs, *et al*. 2013; Howe *et al*. 2014; Burdon *et al*. 2017; Burdon *et al*. 2018). Given this, a better understanding of the value of these cultural services to different beneficiaries can inform coastal ecosystem management. Such knowledge is crucial to ensure that decisions about development or conservation consider the full range, and distribution, of benefits. We use a discrete choice experiment (DCE) to investigate people's preferences for changes in bird biodiversity based on realistic future coastal scenarios, along four measures: species richness, abundance, probability of seeing rare species and the probability of seeing wildlife spectacles. This is the first paper we know of to use stated preference methods to explore the significance of these four measures of biodiversity. Finally, we also highlight the implications for ecosystem management more broadly.

2. Methods

In our study, we used Willingness to Pay (WTP) as a measure of social preferences. WTP can be identified as the amount of money that, if taken away from an individual and used to increase the availability of a public good, leaves their utility constant. In this case, the willingness to pay was for different combinations of the four measures of biodiversity outlined above (biodiversity matrices). An alternative approach would be to use attitudinal questions to gauge social preferences, and indeed in preparing the alternative scenarios for our discrete choice experiment, we drew on such data (see 2.2 below). However, that paradigm of decision theory assumes no resource constraints on people's preferences, and does not force respondents to trade-off increases or decreases in the different measures of biodiversity.

2.1 Discrete Choice Experiments (DCE)

Citizens' preferences for changes in bird biodiversity were elicited by employing a DCE (Louviere et al. 2000; Bateman *et al*. 2002; Lipton *et al*. 2014; Johnston *et al*. 2017), a stated preference survey-based technique widely used in non-market valuation in environmental economics (e.g. Beharry-Borg and Scarpa, 2013; Yao *et al*. 2014). The DCE aims to identify citizens' preferences for different coastal management options. It was devised to explore the trade-offs that people are willing to make from the varying consequences of alternative management options for bird biodiversity. We presented respondents with hypothetical, but realistically designed scenarios relating to bird biodiversity and asked for their preferred options. This allowed us to elicit preferences for alternatives which do not exist: systematic variations in the four measures of bird biodiversity and related policy alternatives. As such, the research does not observe choices made in real markets and challenges to the reliability of such data arise for different reasons, including the cognitive challenge for respondents in deliberating between choices. A key justification for the method is that a stated preference approach allows the research to go over the 'frontier', extending the area of investigation beyond current market choices, in terms of future alternatives, attributes, or attribute levels. The four measures concerned were: number of species, number of individuals, presence of rare species and probability of observing natural spectacles. While we expected people to prefer higher levels of each measure, we also expected preference heterogeneity across different sub-groups of the population, depending on their characteristics.

2.2 Operationalisation: focus groups, pre-test interviews and survey instrument

Focus groups and discussions with stakeholders were employed to determine the attributes in the DCE and to design the survey instrument, which was then finalized using pre-test

interviews. Firstly, the questions were trialled in two workshops in the coastal zones of Essex and Morecambe Bay (n=21 and n=16) based on a broad range of stakeholders involved with the Essex Coastal Forum and Morecambe Bay Partnership respectively. At each workshop, respondents were involved in a deliberative survey, using an electronic voting system to provide preference responses to pictures about bird biodiversity. This technique allowed engagement with the mental construct of biodiversity being used by the respondents, with the aim of improving the construct validity of survey questions. For example, the term 'wildlife spectacle' was found to provide the best description for the variety of bird displays and behaviour which influenced visitor choice. Terms and phrases about 'biodiversity' subsequently used in the questionnaire drew on the distinctions understood by laypeople. For example, respondents suggested that we used the word 'types' instead of 'species' of bird, to aid understanding.

The survey instrument was then pre-tested using face-to-face interviews with a convenience sample of 15 random students, academics and members of the general public in a UK city, to: confirm that the DCE included all important attributes and that respondents understood that those attributes could hypothetically vary independently; assess respondents' ability to understand and accept the survey instrument; and assess that the hypothetical scenarios were acceptable to respondents. Finally, these interviews were used to assess the length and wording of the survey instrument. During the pre-test interviews, respondents were asked to complete the survey instrument while "thinking aloud" – describing their considerations while carrying out the questionnaire.

In the early stage of the questionnaire development we considered different payment methods. After reviewing and testing in focus groups and having discussed different options with stakeholders, such as higher cost of living, increase in local or regional taxes, introduction of a new tax and donation, we decided to use a donation as it was perceived to be a common way of funding activities linked to coastal preservation and bird biodiversity. We had to exclude new taxes or other payment vehicles in the DCE as they were found not to be plausible or acceptable for the type of intervention.

2.3 The survey instrument and experimental design

Respondents were presented with six independent choices between alternative, hypothetical coastal management options. These were options for coastal improvements or infrastructure that third sector organizations could promote and/or implement to avoid long term deterioration caused by human activity to coasts and wildlife in the UK (see appendix A, supplementary info, for the full questionnaire). We asked respondents to consider how a change in policy at the site could impact on bird biodiversity as explained below. This scenario reflects the situation in countries such as the US and UK where conservation charities are significant landowners. It was explained that new funding would be necessary to support long term improvement in environmental quality and that, given the current political and economic situation, funding could only come from citizens' donations. Avian ecologists input knowledge on how attributes might change under different scenarios, and levels of the outcomes were chosen which were meaningful to respondents and avoided cognitive overload (Borger *et al.* 2018). Respondents were asked to select their preference from sets of alternative options, with information provided on the related outcomes for different bird measures. The bird measures used were (choice of levels in brackets):

- The number of **different species** of birds (referred to as 'types' in our questionnaire following piloting, to ensure comprehensibility) that a respondent can see during a visit (decrease, increase, remain at current levels);
- The total **number** of **individual birds** a respondent might see during a visit (decrease, increase, remain at current levels);
- The **probability of seeing a particular type of bird** that is **rare or unusual** (higher, lower, remain at current level);
- The probability of the presence **of a wildlife spectacle** (e.g. thousands of birds in a flock) (higher, lower, remain at current level).

Our study therefore tracked outcomes that can be linked to both structural diversity and functional diversity (in terms of behavioural traits). Each scenario was characterised by a one-off donation required to develop the relevant coastal management options, which ranged between £1 and £15. Including these measures and levels, the DCE was designed employing the four most common 'efficiency under uninformative priors' criteria for the indirect utility coefficients (Ferrini and Scarpa, 2007; Scarpa and Rose, 2008; Kessels *et al.* 2009). We used more than one criterion, updating the design in each of the six waves in order to maximise the statistical power of the DCE and capture as many trade-offs as possible. The final design resulted in sixty-six different choice tasks which were divided into eleven blocks to avoid respondents' fatigue (Campbell *et al.* 2015). An example of a choice task is shown in Figure 1.

Figure 1 Example Choice Card

Attribute	Management option 1	Management option 2	Current Management
Number of different **types** of birds you can see when you visit	Decreased	Decreased	Current
Number of **individual birds** you might see when you visit	Decreased	Current	Current
Likelihood of seeing a particular **type of bird** that is **rare or unusual** for the area	Higher	Higher	Current
Probability of the presence of **wildlife spectacle** (e.g. thousands of birds in a flock)	Current	Higher	Current
Right to **access (proximity)**	No access	Full access	Full access
Cost	**£1**	**£5**	**£0**
choice	☐	☐	☐

2.4 The study sample

A questionnaire was designed and administered online to a representative sample of the UK general population in November 2015, via an online survey. The survey instrument was started by a total of 3,524 respondents randomly selected from the pool of contacts supplied by a research company, screened to be representative of the population in terms of three quotas: male to female ratio, age and employment status, While results from online DCE surveys are often similar to face-to-face interviews, there may be some selection bias resulting from conducting the survey online using an opt-in panel. Given the respondents are drawn from an online panel, this potentially limits the generalizability of the results. However, for the research strategy, this has to be weighed against the tractability of recruiting such a large sample. After eliminating 135 respondents who answered the survey too quickly and/or inconsistently (completed the survey in less than a minute, when the median time for completion was just below 15 minutes, and answered questions with constant pattern – e.g. always the first or the last option) and 389 respondents who did not complete the whole sequence of choices in the DCE, the final sample comprised 3,000 respondents.

2.5 Analytical Framework and Preference Analysis

The analytical framework used for modelling the data in the discrete choice experiments is described in Appendix B, supplementary data. Analysis of DCE data is based on the random utility maximisation (RUM) theory (Thurstone, 1927; Manski, 1977) and the choice probability was modelled using the mixed logit multi-nominal probability function (McFadden and Train,

2000). The clustering of the respondents based on their preferences for biodiversity in coastal areas was conducted using semi-parametric latent class analysis, and clusters selected according to AIC3 criteria (Wedel and Kamakura, 2000).

3. Results

In this section we present the socio-economic characteristics of the sample, with a focus on the variables included in the Latent Class (LC) model, and then report the preference analysis results generated from the Discrete Choice Experiment (DCE) data.

3.1 Descriptive statistics

The sample is broadly representative of the UK population (Table 1). Compared to the general population (UK Census, 2011), our sample is slightly more educated, but similar in terms of income distribution and employment with 54% working full or part time. Households were representative of the average household in the UK, with a size around 2 people per household and about 59% married or living together. In the last 12 months, 77% of respondents had visited a coastal area, while the average distance of respondents' households from the coast was 29 miles.

Table 1 Comparison of Sample with UK Census and ONS data

	Sample	UK Population 2011
N (people)	3,000	63.182 million
Age (years)	45.5	46.5
Female	51%	51%
People per household	1.9	2.3
Marital Status		
Single	28%	34.7%
Married	46%	46.5%
Divorced	8%	8.8%
Living with partner	13%	-
Separated	2%	2.7%
Widowed	3%	7.0%
Employment		
Work full time and self employed	39%	51.6%
Work part time	15%	13.7%
Student	5%	5.8%
Retired	22%	13.9%
Home	8%	4.3%
Unable	5%	6.4%
Unemployed	5%	4.4%
Education		
Other	47%	61%
A-Levels	15%	12%
University degree	38%	27%
Household Gross Annual Income[1]		
less than £10,000	13%	10%
£10,000 to £30,000	45%	45%
£30,001 to £60,000	31%	35%
more than £60,000	11%	10%

1. Data from Effects of Taxes and Benefits on UK Household Income ONS SN7470

3.2 Preference analysis

The multinomial logit model (MNL) indicated that respondents showed significant ($p<0.01$) responses to all variations from the current situation (Table 2). Respondents preferred increases in all biodiversity measures compared to the current situation, and disliked decreases.

The positive coefficient for the current situation suggests that, overall, respondents prefer to maintain the current state of coastal management, while the negative coefficient for cost shows that respondents in general do not like to pay more for the same outcome. Based on the MNL model average WTP for an increase in the number of species of birds in coastal areas is about £5 per household (Table 3). Considering the 22 million households in the UK, this is equivalent to an overall £110 million that could, in theory, be donated to environmental

[1] Data from Effects of Taxes and Benefits on UK Household Income ONS SN7470

organisations for bird conservation in the UK coastal environment. This WTP is significantly higher than those for all the other measures (as shown by the 95% confidence intervals), namely an increase in total number of individual birds; an increased likelihood of seeing rare or unusual species; and an increased in the probability of seeing a wildlife spectacle. These were not statistically different from each other and valued at approximately £3.50 per household.

LC results are presented in the second part of Table 2 and the corresponding WTP for each biodiversity measure in the right hand side of Table 3.

Table 2: Preference analysis, results from MNL and LC models (observations = 18,000, respondents = 3,000).

Attribute	*MNL model*		*LC model*							
			Class 1		**Class 2**		**Class 3**		**Class 4**	
	Coeff	**St. err.**	**Coeff**	**St. err.**	**Coeff**	**St. err.**	**Coeff**	**St. err.**	**Coeff**	**St. err.**
Current situation	0.148***	0.04	2.023***	0.11	-1.979***	0.14	-1.789***	0.18	0.550***	0.13
Decline in number of species	-0.461***	0.04	-0.523***	0.10	-0.238***	0.06	-0.515***	0.06	-1.482***	0.13
Increase in number of species	0.371***	0.02	0.331***	0.09	0.178***	0.05	0.436***	0.05	1.076***	0.09
Decline in total number of birds	-0.357***	0.02	-0.353***	0.10	-0.212***	0.06	-0.439***	0.06	-1.047***	0.09
Increase in total number of birds	0.256***	0.02	0.122	0.09	0.195***	0.05	0.321***	0.05	0.687***	0.07
Decline in incidence of rare species	-0.294***	0.02	-0.384***	0.09	-0.063	0.05	-0.371***	0.06	-0.895***	0.09
Increase in incidence of rare species	0.256***	0.02	0.360***	0.09	0.090*	0.05	0.308***	0.05	0.711***	0.08
Decrease in spectacles	-0.302***	0.02	-0.412***	0.10	-0.144**	0.06	-0.343***	0.05	-0.947***	0.09
Increase in spectacles	0.237***	0.02	0.442***	0.09	0.162***	0.05	0.249***	0.05	0.580***	0.07
Cost	-0.070***	0.02	-0.342***	0.03	-0.223***	0.02	0.051***	0.01	-0.119***	0.01
LC – Membership probability	**100%**		**37.91%**		**21.45%**		**20.34%**		**20.30%**	
Model for Classes			**Coeff**	**St. err.**	**Coeff**	**St. err.**	**Coeff**	**St. err.**	**Coeff**	**St. err.**
Intercept			0.378**	0.15	0.425*	0.23	-0.328	0.22	-0.474*	0.25
Female (Y/N)			-0.073	0.07	-0.066	0.09	-0.095	0.09	0.234**	0.10
Age			0.013***	0.00	-0.015***	0.00	0.001	0.00	0.000	0.00
Age not disclosed (Y/N)			0.841***	0.24	-0.852***	0.39	0.246	0.32	-0.235	0.39
Visited the coast in last year (Y/N)			-0.294***	0.07	0.050	0.11	0.213**	0.11	0.031	0.11
Member of Environmental Org. (Y/N)			-0.507***	0.09	-0.027	0.12	0.291***	0.10	0.243**	0.11
Income: £10K - £30K			-0.165*	0.10	0.101	0.15	-0.060	0.14	0.124	0.16
Income: £30K to £60K			-0.340***	0.11	0.121	0.16	-0.010	0.15	0.229	0.17
Income: more than £60K			-0.318***	0.13	-0.166	0.19	0.114	0.18	0.370**	0.19
Log-likelihood	-18,097.10		-13,937.30							
parameters	10		67							
AIC	36,214.3		28,020.6							
BIC	36,274.4		28,459.1							

Notes: * p<0.1; ** p<0.05; *** p<0.01; only those variables significant in the final selected model are presented – variables not significant in the LC model were marital status, employment status, level of education achieved, number of dependent children in the household, number of people in the household. In this study, coefficients in the class membership probability are effect-coded. It is therefore possible to estimate coefficients for C-1 classes and retrieve (as the negative sum of the non-omitted classes) the coefficients for the omitted class.

Table 3: Welfare analysis (WTP) from MNL and LC models.

Attribute	MNL model		LC model					
	MNL		Class 1		Class 2		Class 4	
	WTP (£)	95% C.I.	WTP (£)	95% C.I.	WTP (£)	95% C.I.	WTP (£)	95% C.I.
Decline in number of species	*-6.58***	[-7.27 to -5.88]	*-1.53***	[-2.17 to -0.89]	*-1.07***	[-1.59 to -0.54]	*-12.50***	[-16.23 to -8.77]
Increase in number of species	*5.29***	[4.74 to 5.85]	*0.97***	[0.44 to 1.50]	*0.80***	[0.33 to 1.27]	*9.08***	[6.51 to 11.65]
Decline in total number of birds	*-5.09***	[-5.71 to 4.47]	*-1.03***	[-1.63 to -0.43]	*-0.95***	[-1.44 to -0.46]	*-8.83***	[-11.29 to -6.37]
Increase in total number of birds	*3.66***	[3.16 to 4.15]	*0.36*	[-0.17 to 0.89]	*0.87***	[0.44 to 1.31]	*5.80***	[4.25 to 7.34]
Decline in incidence of rare species	*-4.19***	[-4.77 to 3.61]	*-1.13***	[-1.67 to -0.58]	*-0.28*	[-0.75 to 0.19]	*-7.55***	[-9.85 to -5.25]
Increase in incidence of rare species	*3.65***	[3.16 to 4.13]	*1.05***	[0.55 to 1.56]	*0.40*	[-0.05 to 0.85]	*5.99***	[4.24 to 7.74]
Decrease in spectacles	*-4.30***	[-4.91 to -3.70]	*-1.21***	[-1.81 to -0.60]	*-0.64***	[-1.13 to -0.15]	*-7.99***	[-10.32 to -5.65]
Increase in spectacles	*3.38***	[2.90 to 3.87]	*1.29***	[0.79 to 1.80]	*0.72***	[0.26 to 1.19]	*4.89***	[3.47 to 6.31]

Note: * p<0.1; ** p<0.05; *** p<0.01 Given the positive cost coefficient WTP are not computed for Class 3.

Class 1 respondents (the largest class) have a positive coefficient for the current situation and the strongest aversion to donate (cost), leading to low levels of WTP. Nevertheless, preferences for changes in biodiversity measures are statistically significant (at $p<0.01$) for all except an increase in the number of birds. Respondents in this class were more likely to be older, less likely to have visited the UK coast in the last year and less likely to be members of environmental organizations than those in other classes. Interestingly, and coherent with their higher cost aversion compared to other classes, respondents with lower income were more likely to be members of this class.

Class 2 respondents had a negative preference for the 'no intervention' option. This class also differs from the others and from the MNL estimates as they exhibit a lower level of preference for the probability of seeing rare birds. As in the previous class, respondents associated with this class also have a fairly high aversion to cost, and low WTP (Table 3). This class was associated with younger respondents (Table 2).

Class 3 respondents showed strong positive preferences for increases (and strong negative preferences for decreases) in all measures of bird biodiversity. All coefficients have the expected sign and are highly statistically significant and the coefficient associated with the current situation is negative. Unusually, the cost coefficient is positive meaning that respondents in this class would prefer higher costs, all else equal. Respondents in this class were likely to be environmental NGO members and visitors to the UK coast. As the cost coefficient was positive, it was not possible to compute meaningful WTP measures and this class is excluded from Table 3.

Class 4 respondents had the strongest preferences for improvements across all bird biodiversity measures and the highest WTP, resulting from a very low cost aversion. Indeed respondents in this class have a cost coefficient one third of that in class 1 and half that in class 2. They were also characterised by a positive and statistically significant coefficient for the 'no improvement' (Current Situation) option. Respondents in this class tended to have the highest incomes, to be female and members of environmental organizations.

4. Discussion: preferences for different measures of biodiversity

The analysis of survey results from the MNL model shows that all four measures of bird biodiversity are important determinants of people's choices, in line with our hypotheses of public support for improved biodiversity. Preferences for higher species richness have been seen previously (e.g. Lindemann-Matthies *et al*. 2010; Luck *et al*. 2011), as have a relationship between species richness and wellbeing outcomes (e.g. Dallimer *et al*. 2012). Given the representative nature of our sample, our results provide some warrant for UK ecosystem services assessments to suggest that scenarios which enhance biodiversity relating to birds, but also more broadly, will improve flows of cultural ecosystem services. Although our results do not allow us to infer the form of any functional response of preference to number of species (c.f. Luisetti *et al*. 2011), they are useful in highlighting the significance of species richness relative to other measures of biodiversity, but also the importance of all four measures. Future studies should explore further precision of metrics which could be used to evaluate this (Johnston *et al*. 2012). Conservation measures which target a particular metric are likely to benefit other measures too, but it is still possible for people to separately conceptualise these metrics and furthermore public access infrastructure could be designed

to enhance the experience of certain metrics. The segmentation provided by the LC model shows that these preferences are not homogeneous and that social and broader cultural characteristics play an important role. We find evidence for four classes of respondent, with income, age, membership of environmental NGOs, visit rate to coastal (nature) settings, and gender characterizing the classes. While the actual values that people seem prepared to pay would need to be validated by testing in real-life situations, the relative values for different options, and between different respondent classes, are extremely informative. Interestingly, in the MNL results, and most classes of the LC analysis, the coefficients for decreases tend to be larger than for increases in the biodiversity measures. This may indicate loss aversion or declining marginal WTP (as found by Luisetti *et al*. 2011), or that respondents believe that avoiding loss is more plausible than achieving gains in biodiversity.

Class 3 respondents show a positive coefficient for price: they have a positive preference to donate a higher amount of money to implement a specific coastal management option. This is contrary to standard theory. It could be an artefact of the survey instrument, in particular the choice of a voluntary donation as the payment vehicle. Alternatively it could be due to a warm glow or sense of altruism associated with making donations (Meyerhoff & Liebe, 2006) or social desirability bias, leading them to answer the question in ways that they believe will be viewed favourably by others (Andreoni, 1990). However, it is also possible that respondents in this class believe that small(er) amounts of money cannot actually change the situation and they are therefore perceiving price as signalling other attributes such as chance of success. Just as consumers tend to identify high price of extra virgin olive oil as a quality indicator, often purchasing the most expensive products on sale (Scarpa and Del Giudice, 2004; Cicia *et al*. 2002; Di Vita *et al*. 2013), the donation can be seen as a proxy for 'quality'. This would justify respondents' willingness to donate higher amounts (all other things being equal) in order to ensure a high quality and meaningful improvement to coastal bird biodiversity. Respondents who visit the coast and are members of environmental organizations are most likely to be in this class. This further explains the positive preference for higher donation, and why that reflects rational economic behaviour for this class of respondents, assuming the money donated could be related to the quality of the intervention. Such an interpretation is also supported by our research to establish the validity of the survey instrument. In this case, there was strong support for donations, rather than contributing by paying an additional tax. Indeed, as expected from the focus groups and discussion with stakeholders, people are used to the idea that this type of activity is funded by donation and that their choices reflect their actual willingness to pay. Because it is impossible to know for certain the reasons for this positive coefficient, we would urge caution when interpreting the magnitudes of WTP from this group. Nevertheless, we believe the main finding that respondents appear to value all four measures of biodiversity is unaffected.

5. Implications for policy and practice

5.1 Nature conservation and protected area management

Third sector organisations play a key role in nature conservation, with voluntary donations providing a major proportion of funding (Somper, 2011). The segmentation found in WTP has implications for environmental organizations working on biodiversity on the UK coast. For example, this understanding could help organisations target different segments of the population with different messages to raise awareness, or request different amounts of donations to raise support. For example, there is an argument to propose a recurring

donation to members of Class 3, suggesting that this could improve the quality of coastal management, while for Class 4, a one-off donation requested could be higher than that for Class 1 and 3, as members of Class 4 are less cost sensitive. Furthermore, there is an interesting difference between classes in the degree to which respondents would pay for positive improvement (classes 2 and 3) versus respondents who would pay to avoid deterioration (classes 1 and 4). Finally, the first two classes could be attracted by the option to provide small donations, e.g. online or at events away from the coast. The results support the maintenance of species, and rare species, in protected area management, but they also underline the importance of managing sites for other biodiversity measures, including the abundance of birds and the spectacles which may result.

5.2 Bird habitat creation in climate adaptation and development schemes

Coastal ecosystems, including those which are important for migratory birds, are subject to highly dynamic land-sea interactions, and under future scenarios of rising sea-levels resulting from human induced climate change, face pressure from 'coastal squeeze'. Habitat creation through managed realignment is an increasingly important response with over 100 schemes in Europe and North America alone covering 13 000 ha (Estevez, 2014) and evidence that these can create meaningful waterbird assemblages (Mander *et al*. 2007). In seeking to negotiate trade-offs between services such as flood risk, food production, nature conservation, public amenity and other factors, many such schemes have proposed sensitive public access as a benefit. The findings of this paper support this justification that initiatives such as the creation of reserve infrastructure may result in increased cultural ecosystem services, for example, by increasing the probability of seeing wildlife spectacles (Bhatia, 2011). Notably, while the selection criteria and conservation objectives for protected areas such as EU SPAs typically focus on the numbers of individual species or overall assemblage of birds that regularly occur on a site (Stroud *et al*. 2016), this work also found that other measures of biodiversity were important in determining WTP. Well-designed infrastructure in coastal developments and habitat restoration schemes, which maximise wildlife interaction, could therefore create improved cultural ecosystem services, especially in sites close to where people live.

High development pressures in the coastal zone are well attested. An ecosystem services approach can be proactive about assessing the risks of development for bundles of ecosystem services, moving beyond consideration of impacts on media of air, soil or water (Baker, 2013). However, to consider impacts on biodiversity and the implications for cultural ecosystem services, such an approach should draw on an understanding of social determinants in estimating the net benefits of coastal development. Our model showed a stratification of social groups, including those which are highly supportive of biodiversity (Class 3); those who are willing to support biodiversity as part of a bundle of ecosystem service benefits (Class 4); and a further significant proportion who visit the coast less often and are unlikely belong to an environmental NGO which might be taken as an indicator of conservation interests (Class 1). Understanding the significance of cultural ecosystem services implies understanding the variation in population perceptions (Jefferson *et al* 2014). Such an approach is recognised in policies such as the UK 25 year Environment Plan, which highlights working with stakeholders to value ecosystem services. Valuations based on simple assertions that proximity to nature will induce benefits in well-being to all, miss the point that conservation has further work to do in improving public understanding and experience.

6. Conclusions

The ecosystem services framework is commonly presented as a conceptual model with a cascade of interactions between biodiversity, ecosystem processes, ecosystem services, goods & benefits and human wellbeing. This demands improved understanding of the cultural pathways by which humans value biodiversity. This paper provides two major contributions. Firstly, instead of using a single measure of biodiversity, the research assessed multiple dimensions of avian biodiversity, and found that several components are consistently valued, including the number of species (species richness), the number of individual birds (abundance), the probability of seeing rare or unusual species, and the probability of seeing large flocks (wildlife spectacles). As such, public preferences are broader than just the abundance of each species present on a site, the measure that is usually the basis for the selection of sites for protection. Further research which explores preference saturation rates for these diverse biodiversity measures, across a range of species groups, is warranted. Secondly, by conducting latent class analysis of a discrete choice experiment, from a representative sample of a national population, the research found evidence for key determinants of preference for human beneficiaries. Since planning and management decisions are a matter of social choice, it is important to understand the social determinants which influence the range of societal preferences- the social filters which affect perceptions of biodiversity (Pett *et al*. 2016) and engage different sectors of society.

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Declaration of interests

 The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Boeri: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Review & Editing, Project Administration

Stojanovic: Conceptualization, Methodology, Investigation, Resources, Writing - Original Draft, Writing - Review & Editing, Project Administration

Wright: Conceptualization, Methodology, Investigation, Resources, Writing - Review & Editing.

Burton: Conceptualization, Methodology, Investigation, Resources, Writing - Review & Editing, Project Administration

Hockley: Conceptualization, Methodology, Validation, Formal analysis, Writing - Review & Editing.

Bradbury: Conceptualization, Investigation, Resources, Writing - Review & Editing, Project Administration

Start of Block: Intro and consent

Thank you for your interest in our survey. This study is part of the CBESS research project, in which Nine UK universities and two government organizations are working together to understand how society benefit from nature.

http://www.nerc-bess.net/index.php/bess-projects-list/research-projects/42-cbess

If you decide to take part, you will be invited to consider a series of questions on UK coastal area management, and in particular on two regions, namely Morecambe Bay and the Essex Coast.
Some of the questions will be related to hypothetical scenarios. Although the questions do not relate in any way to decisions currently under review, we would ask you to make decisions as if you were to make actual choices.

By taking part in this study you are helping researchers understand how the general public value the coastal environment, in particular biodiversity, on the Essex Coast and Morecambe Bay. We use birds as an indicator of wider biodiversity. All data collected throughout the study will be anonymous. The study should take no longer than 15/20 minutes and you are free to withdraw at any time.

In this survey we are interested in **your** preferences for recreation in (and management of) the Essex Coast and Morecambe Bay. There are no right or wrong answers; we are interested in **YOUR OPINIONS.**

If you have any questions about the study, please do not hesitate to contact [redacted]

I give informed consent to participate in this study

- ○ Yes (1)
- ○ No, I do not want to participate (0)

End of Block: Intro and consent

Start of Block: Screening questions

Part A is common to everybody.

PART A: Screening questions.

1.1 Please give your postcode (in capital letters with a space in-between - eg. BT9 7BL)

_____

1.2 What year were you born?

_____

1.3 What gender are you?

- ○ Male (0)
- ○ Female (1)

1.4 What is your marital status?

- ○ Single (never married) (1)
- ○ Married (2)
- ○ Living as married (3)
- ○ Divorced (4)
- ○ Separated (5)
- ○ Widowed (6)

1.5 What best describes your employment status?

- ○ Working full-time (30 hours or more per week) (1)
- ○ Working part-time (Less than 30 hours per week) (2)
- ○ Unemployed (3)
- ○ Student (4)
- ○ Retired (5)
- ○ Homemaker (6)
- ○ Unable to work due to health reasons (7)

1.6 Have you visited any coastal areas in the UK for recreational reasons in the last 12 months?

- ○ Yes (1)
- ○ No (0)

End of Block: Screening questions

PART B: Choosing your preferred Management of Morecambe Bay/the Essex Coast Contingent valuation; This part will be on:

1. Managed realignment (allowing some areas of land to be flooded by the sea to protect other areas from flooding due to storm surge events or sea-level rise) (+ birds)

2. Coastal housing development (which may increase disturbance to coastal wildlife due to the right for people to access the coast. It may also change the aesthetic value of coastal areas) (+ birds)

3. Pollution (e.g. from agricultural chemicals that may wash into rivers and accumulate in estuaries) (+ birds)

4. The provision of infrastructure to allow people to get close to coastal wildlife, such as paths and bird hides (+birds)

Start of Block: Descr coast management

Current management for coastal land and wildlife in the UK is undertaken by charities, voluntary organisations, government environmental agencies and by local city and town councils. They tackle different issues such as:

(1) **Managed realignment** (allowing some areas of land to be flooded by the sea to protect other areas from flooding due to sea-level rise);
(2) **Coastal housing development** (which may increase disturbance to coastal wildlife due to the right for people to access the coast. It may also change the aesthetic value of coastal areas);
(3) **Pollution** (e.g. from agricultural chemicals that may wash into rivers and accumulate in estuaries); and
(4) **The provision of infrastructure** to allow people to get **close** to **coastal wildlife**, such as paths and bird hides.

To avoid long term damages caused by human activity to coasts and wildlife in the UK, new funding would be necessary to support a rational management strategy for four plans that would cover the four issues described above.

Q10 Which of the above mentioned issues do you consider most important?

- ○ **Managed realignment** (allowing some areas of land to be flooded by the sea, at least in part, to protect other areas from flooding due to sea-level rise) (1)
- ○ **Coastal housing development** (which may increase disturbance to coastal wildlife due to the right for people to access the coast. It may also change the aesthetic value of coastal areas) (2)
- ○ **Pollution** (e.g. from agricultural chemicals that may wash into rivers and accumulate in estuaries) (3)
- ○ The provision of **infrastructure** to allow people to get **close** to **coastal wildlife**, such as paths and bird hides (4)

In the next four questions, you will be asked whether or not you would support **four** separate **hypothetical programmes to manage coastal areas in the UK**. Each programme is associated with a cost that would be covered with an increase in household taxes charged on an annual basis for five years from 2016 to 2020.

Suppose that **four independent polls at the local government** level were proposed for implementing the management for each of the four plans. **If in each poll the majority of people voted in favour, the management of that plan would go ahead and households would pay increased tax for the next five years**.

You will be asked to vote twice (with different taxation level) for each poll, consider each vote **independent**. Before voting, keep in mind that the money you would commit to pay for these programs would be money not available to you for other expenses.

But also remember that there are no right or wrong answers; we are only interested in your opinion.

End of Block: Description coast management

Start of Block: CV - Manag reallignement - no birds

Managed realignment (no birds)

Managed realignment

Managed realignment means allowing some areas of land to be flooded by the sea. It is used as a way of managing the impact of sea-level rise due to climate change and also to compensate for coastal habitat lost elsewhere to development.

Allowing some areas of land to flood in this way helps to reduce the flood risk or the cost of flood defence in other nearby areas. It creates a new area that can take up some of the water when the coast flood due to high tides or storm surges. Agricultural land is usually used for managed realignment projects, while nearby residential areas are protected from flooding.

So what does a managed realignment project look like?
A new sea wall (which will eventually look like a large grassy bank) is built around the area of land that will be allowed to flood, then a hole is made in the old sea wall to allow seawater to move in and out of the area with the tides.

managnob_1
Would you vote in favour in a poll for this management programme funded through a household tax of £${e://Field/bid1_pol1} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:
If managnob_1 = 1

What if the cost per household was higher?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of £${e://Field/bid2Yes_pol1} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:
If managnob_1 = 0

managnob_3 **What if the cost per household was lower?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of £${e://Field/bid2No_pol1} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Coastal housing development (no birds)
Coastal housing development

Coastal housing developments may provide an attractive place for people to live, and help to meet the country's requirement for new housing.

Bringing new people into the area may benefit the local economy. However, it can also have some negative impacts. New housing developments can change how coastal areas appear.

A right for the public to access coastal areas, and increasing the local population (by building new houses) also means that more people are likely to visit the coast.

coast_nob1
Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£${e://Field/bid1_pol2}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:
If coast_nob1 = 1

coast_nob2
What if the cost per household was higher?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£${e://Field/bid2Yes_pol2}** per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:
If coast_nob1 = 0

coast_nob3
What if the cost per household was lower?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£${e://Field/bid2No_pol2}** per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

End of Block: CV Coastal housing development - no birds

Start of Block: CV Pollution (Nutrient run off) - no birds

Pollution (no birds)
Pollution (nutrient run off)

Various types of pollution can affect coastal areas. However, here we are just considering one type called “nutrient run off”.

This is where nutrients from the land (often from agricultural chemicals such as fertilizers, but

also from sewerage systems) are washed into streams and rivers, and eventually end up at the coast where they accumulate in saltmarshes and mudflats. This can cause an excess of nutrients in coastal areas (sometimes called “eutrophication”) which can lead to saltmarshes and mudflats becoming smelly and unpleasant places to visit. Large “algal mats” may also form on the surface of the mudflats.

Nutrient run off can be reduced by careful management of the land around rivers that feed into coastal areas, including saltmarshes and mudflats. This can include restricting the amount of agricultural chemicals used on the land, restricting the timing of their use (e.g. avoiding periods when heavy rain is forecast), or finding other ways to prevent nutrients from running off the land into water courses.

Poll_nob1 Would you vote in favour in a poll for this management programme to reduce nutrient run-off, funded through a household tax of **£${e://Field/bid1_pol3}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:

If Poll_nob1 = 1

Poll_nob2 **What if the cost per household was higher?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to reduce nutrient run-off, funded through a household tax of **£${e://Field/bid2Yes_pol3}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:

If Poll_nob1 = 0

Poll_nob3 **What if the cost per household was lower?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to reduce nutrient run-off, funded through a household tax of **£**${e://Field/bid2No_pol3} per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Page Break

End of Block: CV Pollution (Nutrient run off) - no birds

Start of Block: CV infrastructure - nobirds

Infrastructure (no birds)

Provision of infrastructure, such as paths and bird hides, to allow people to get close to coastal wildlife

A wide variety of plants and animals occur in coastal areas, especially on salt marshes and mudflats, but they can often be spread over a wide area which may not be easily accessible, and therefore it can be hard for people to get up close and experience the nature in these areas.

The provision of infrastructure, such as access paths and bird hides, can allow people to get much closer to nature and attract tourists.

Adding information boards to help visitors to identify plants and animals, and understand more about what they can see, can also increase the quality of their experience of nature in the area.

infra_nob1
Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£**${e://Field/bid1_pol4} per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:
If infra_nob1 = 1

infra_nob2
What if the cost per household was higher?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£${e://Field/bid2Yes_pol4}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:
If infra_nob1 = 0

infra_nob3 **What if the cost per household was lower?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£${e://Field/bid2No_pol4}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

End of Block: CV infrastructure - nobirds

Managed realignment (with birds)
Managed realignment

Managed realignment means allowing some areas of land to be flooded by the sea. It is used as a way of managing the impact of sea-level rise due to climate change and also to compensate for coastal habitat lost elsewhere to development.

Allowing some areas of land to flood in this way helps to reduce the flood risk or the cost of flood defence in other nearby areas.It creates a new area that can take up some of the water when the coast flood due to high tides or storm surges. Agricultural land is usually used for managed realignment projects, while nearby residential areas are protected from flooding.

Managed realignment can also provide benefits for wildlife. Coastal areas such as saltmarshes and mudflats are important for wildlife, but sea-level rise and development is reducing the amount of these habitats. Managed realignment projects can create new areas of saltmarsh or mudflat on the land that is allowed to flood.

Managed realignment projects are often designed to **benefit birds** and may influence the birds you see when you visit the coast in the following ways:

- It could **increase the numbers of birds** you can see when you visit the coast;
- it will **increase the chance of seeing** a wider variety of types of bird.

- In the case of the sites relevant for the CBESS project, it could increase your chances of seeing birds such as **Brent Geese** on the **Essex Coast** in the winter, for which this region **is particularly important.** It could similarly increase your chance of seeing birds swirling flocks of small wading birds such as **Knot, Dunlin and Sanderling**, which are characteristic of **Morecambe Bay** in the winter.

  So what does a managed realignment project look like?
  A new sea wall (which will eventually look like a large grassy bank) is built around the area of land that will be allowed to flood, then a hole is made in the old sea wall to allow seawater to move in and out of the area with the tides.

managbi_1 Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid1_pol1}** per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:

If managbi_1 = 1

managbi_2 What if the cost per household was **higher**?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid2Yes_pol1}** per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:

If managbi_1 = 0

managbi_3 What if the cost per household was **lower**?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid2No_pol1}** per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

End of Block: CV - manag realignement - birdsbio

Start of Block: CV Coastal housing development - birdsBio

Coastal housing development (with birds / bio)
Coastal housing development

Coastal housing developments may provide an attractive place for people to live, and help to meet the country's requirement for new housing.

Bringing new people into the area may benefit the local economy. However, it can also have some negative impacts. New housing developments can change how coastal areas appear.

A right for the public to access coastal areas, and increasing the local population (by building new houses) also means that more people are likely to visit the coast.

Disturbance to wildlife associated with coastal housing development can be managed by either restricting the development of new coastal housing, or restricting access to sensitive areas nearby.

This can also **benefit birds** and may influence the birds you see when you visit the coast in the following ways:

- It could **increase the numbers of birds** you see when you visit the coast, but you may have more distant views of the birds due to access restrictions;
- it will **increase the chance of seeing a wider variety of types of bird**, but you may have more distant views of the birds due to access restrictions

- In the case of the sites relevant for the CBESS project, it could increase your chances of seeing birds such as **Brent Geese** on the **Essex Coastin the winter**, for which this region is **particularly important**, but you may have more distant views of the birds. It could similarly increase your chance of seeing **swirling flocks** of small wading birds such as **Knot, Dunlin and Sanderling**, which are characteristic of **Morecambe Bay in the winter**. However you may have more distant views of the birds.

coast_b1 Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£**${e://Field/bid1_pol2} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:

If coast_b1 = 1

coast_b2 What if the cost per household was **higher**?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£**${e://Field/bid2Yes_pol2} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Display This Question:

If coast_b1 = 0

coast_b3 What if the cost per household was **lower**?
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme to restrict public access to sensitive areas for wildlife funded through a household tax of **£**${e://Field/bid2No_pol2} per year that you would have to pay for 5 years from 2016 to 2020?

- Yes (1)
- No (0)

Pollution (with birds / bio)
Pollution (nutrient run off)

Various types of pollution can affect coastal areas. However, here we are just considering one type called “nutrient run off”.

This is where nutrients from the land (often from agricultural chemicals such as fertilizers, but also from sewerage systems) are washed into streams and rivers, and eventually end up at the coast where they accumulate in saltmarshes and mudflats. This can cause an excess of nutrients in coastal areas (sometimes called “eutrophication”) which can lead to saltmarshes and mudflats becoming smelly and unpleasant places to visit. Large “algal mats” may also form on the surface of the mudflats.

Nutrient run off can be reduced by careful management of the land around rivers that feed into coastal areas, including saltmarshes and mudflats. This can include restricting the amount of agricultural chemicals used on the land, restricting the timing of their use (e.g. avoiding periods when heavy rain is forecast), or finding other ways to prevent nutrients from running off the land into water courses.

Reducing Nutrient run off can also have an **impact on birds** and may influence the birds you see when you visit the coast in the following ways:

- It could increase **the numbers of birds** you see when you visit the coast;
- It could increase the chance of seeing a **wider variety of types of bird**.

- In the case of the sites relevant for the CBESS project, it would **decrease your chances of seeing birds such as Brent Geese on the Essex Coast in the winter, for which** this region is particularly important. It could similarly **increase** your chance of seeing swirling flocks of small wading birds such as **Dunlin, Knot and Sanderling**, which are characteristic of **Morecambe Bay**.

Poll_b1 Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid1_pol3}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:

If Poll_b1 = 1

Poll_b2 **What if the cost per household was higher?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid2Yes_pol3}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:

If Poll_b1 = 0

Poll_b3 **What if the cost per household was lower?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for this management programme funded through a household tax of **£${e://Field/bid2No_pol3}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Infrastructure (with birds / bio)

Provision of infrastructure, such as paths and bird hides, to allow people to get close to coastal wildlife

A wide variety of plants and animals occur in coastal areas, especially on salt marshes and mudflats, but they can often be spread over a wide area which may not be easily accessible, and therefore it can be hard for people to get up close and experience the nature in these areas.

The provision of infrastructure, such as access paths and bird hides, can allow people to get much closer to nature and attract tourists.

Adding information boards to help visitors to identify plants and animals, and understand more about what they can see, can also increase the quality of their experience of nature in the area. The provision of infrastructure to allow **people to get close to coastal wildlife**, particularly on reserves, is often undertaken as part of a larger package of measures aimed at providing both habitat management for the **benefit** of **wildlife and visitor management**.

Combined, this package may **influence the birds** you see when you visit the coast in the following ways:

- It could **increase the numbers of birds** you see when you visit the coast, and allow you to get closer views of them;
- It could increase the chance of seeing a **wider variety of types of bird**, and allow you to get closer views of them.

- In the case of the sites relevant for the CBESS project, it could increase your chances of seeing birds such as **Brent Geese on the Essex Coast in the winter, for which** this region is particularly **important**, and allow you to get closer views of them. It could similarly increase your chance of seeing swirling flocks of small wading birds such as **Knot, Dunlin and Sanderling**, which are characteristic of **Morecambe Bay in the winter**, and **increase the numbers of Oystercatchers** and allow you to get closer views of them.

infra_Bio1 Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£${e://Field/bid1_pol4}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:
If infra_Bio1 = 1

infra_Bio2 **What if the cost per household was higher?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£${e://Field/bid2Yes_pol4}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

Display This Question:
If infra_Bio1 = 0

infra_Bio3 **What if the cost per household was lower?**
(Please consider this independently from the previous question)

Would you vote in favour in a poll for the provision of infrastructure to allow people to get close to coastal biodiversity, funded through a household tax of **£${e://Field/bid2No_pol4}** per year that you would have to pay for 5 years from 2016 to 2020?

- ○ Yes (1)
- ○ No (0)

PART C: Choosing your preferred Management for UK Coast

In the previous section you were presented with four separate public programmes to manage the UK coasts to tackle different issues such as Managed realignment, Coastal development, Pollution, and infrastructure to allow people to get close to coastal wildlife.

In this section you will examine different coastal management options that volunteer and non-profit organizations could put in place if money were available through public donations. To avoid long term damages caused by human activity to coasts and wildlife in the UK, new funding would be necessary to support a rational management strategy.

You will be presented with 6 sets of alternative options of management, and outcomes of those management, for the UK coasts to be preserved. You will be asked to select your preferred option in terms of different characteristics and the associated donation.

Before choosing, keep in mind that the money you would commit to donate for these programs would be money not available to you for other expenditures. There are no right or wrong answers; we are only interested in your opinion.

Possible characteristics which might be altered by a change in policy at the site:

1. The number of **different types** of birds you can see when you visit. This can:
   - decrease
   - increase
   - remain at current levels

2. The total **number** of **individual birds** you might see when you visit (regardless of whether they are all one type or lots of different types). This can:
   - decrease
   - increase
   - remain at current levels

3. The **likelihood of seeing a particular type of bird** that is **rare or unusual** for the area. This can be:
   - Higher
   - Lower
   - At current level

4. The probability of the presence of wildlife spectacle (e.g. thousands of birds in a flock). This can be:
   - Higher,
   - Lower,

- At current levels.

5. Right to access (getting in proximity of birds and biodiversity). The Access is currently not limited in most of UK coastal areas; it can be managed (managed access) or fully prohibited (No access)

6. The donation you are going to be asked to develop the different options of management in coastal areas ranges between 1 and 15 pounds.

Below you will be presented with three management programmes. The first two are alternative, hypothetical, management options, while the third on the right hand side is the current program. Choose the program that you prefer. You will be asked to select your favourite alternative 6 times on different, independent, occasions.

[Efficient design requires the development of multiple versions of the design which then was split in blocks. Each respondent should see one block of 6 questions.
Example DCE question:]

choice task 1 **Block** 1

Attribute	Management option 1	Management option 2	Current Management
Number of different **types** of birds you can see when you visit	Decreased	Decreased	Current
Number of **individual birds** you might see when you visit	Decreased	Current	Current
Likelihood of seeing a particular **type of bird** that is **rare or unusual** for the area	Higher	Higher	Current
Probability of the presence of **wildlife spectacle** (e.g. thousands of birds in a flock)	Current	Higher	Current
Right to **access (proximity)**	No access	Full access	Full access
Cost	**£1**	**£5**	**£0**
choice	☐	☐	☐

Start of Block: Recreational activity

Part D: recreational activity

Part C is common to everybody.

Part C: Morecambe Bay and the Essex Coast

From this point, the questionnaire is focussed on the sites relevant for the CBESS project: Morecambe Bay and the Essex Coast (highlighted with a circle in the map).

Study sites

Q18 Have you visited Morecambe Bay within the last 12 months?

- Yes (1)
- No (0)

Q19 Have you visited the Essex Coast within the last 12 months?

- Yes (1)
- No (0)

Q172 Are you planning to visit Morecambe Bay in the next 12 months?

- Yes (1)
- No (0)

Q173 Are you planning to visit the Essex Coast in the next 12 months?

- Yes (1)
- No (0)

End of Block: Recreational activity

Start of Block: Recreation Morecambe Bay

Q20 How many **trips** in total did you make to **Morecambe Bay** within the last 12 months?

Q21 Did any of these trips involve an overnight stay?

- Yes (1)
- No (0)

Display This Question:

If Q21 = 1

Q22 How many **days** in total did you spend in **Morecambe Bay** area within the last 12 months?

Q23 How many miles did you travel to get to **Morecambe Bay** (one way distance)?

Q24 How did you get there? (Tick all that apply).

- ☐ Car (1)
- ☐ Bus (2)
- ☐ Taxi (3)
- ☐ Walking (4)
- ☐ Bicycle (5)
- ☐ Motorbike (6)
- ☐ Other (please specify) (7) _____

Q25 Who did you travel with to **Morecambe Bay** (Tick all that apply).

- ☐ Family (1)
- ☐ Friends (2)
- ☐ Partner (3)
- ☐ Co-workers (4)
- ☐ Group outing (5)
- ☐ I've travelled alone (7)
- ☐ Other (please specify) (6) _____

Q26 How much time (including your travel) did you spend on your last trip to **Morecambe Bay** area? (Tick all that apply).

- ☐ Morning (1)
- ☐ Afternoon (2)
- ☐ Evening (3)
- ☐ All day (4)
- ☐ Overnight (5)
- ☐ More than one night (please specify how many) (6)

_____

Display This Question:

If Q26 = 6

Or Q21 = 1

Q27 When you stayed overnight, which type of accommodation did you use during your stay? (Tick all that apply).

- [ ] Hotel (1)
- [ ] Hostel (2)
- [ ] Campsite (Touring / Tent) (3)
- [ ] Campsite (Static) (4)
- [ ] Friends (5)
- [ ] Second Home (6)
- [ ] B&B (7)
- [ ] Family (8)
- [ ] Self Catering (9)

Display This Question:

If Q26 = 6

Or Q21 = 1

Q28 What was the cost of your accommodation per person per night?

- ○ £0 (1)
- ○ £1-£15 (2)
- ○ £16 - £30 (3)
- ○ £31 - £45 (4)
- ○ £46 - £60 (5)
- ○ £61 - £75 (6)
- ○ £76 - £90 (7)
- ○ £91 + (8)

Q29 **EXCLUDING ACCOMMODATION COSTS,** how much money did you spend during your last visit to **Morecambe Bay?** (food, drink, transport costs, entrance fees, parking fees, activities etc).

- ○ £0 (1)
- ○ £1-£15 (2)
- ○ £16 - £30 (3)
- ○ £31 - £45 (4)
- ○ £46 - £60 (5)
- ○ £61 - £75 (6)
- ○ £76 - £90 (7)
- ○ £91 + (8)

Q30 How many days do you intend to spend in **Morecambe Bay** area in the next 12 months?

_____

End of Block: Recreation Morecambe Bay

tim_q1mor
What do you usually do when visiting coastal environment such as **Morecambe Bay**? (Tick all that apply and select the most common).

- [ ] Business (1)
- [ ] Entertainment (2)
- [ ] Dining (3)
- [ ] Visit friends / Relatives (4)
- [ ] Holiday / break (5)
- [ ] Birding (6)
- [ ] Cycling (7)
- [ ] Fishing/Angling (8)
- [ ] Golfing (9)
- [ ] Hang Gliding/Paragliding/Kite jumping (10)
- [ ] Horse Riding (11)
- [ ] Land Yachting (kite buggying, kite flying) (12)
- [ ] Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- [ ] Model Plane Flying/Micro lights (14)
- [ ] Natural History (15)
- [ ] Off Road Motoring (motorcycles, buggies and 4x4) (16)

- [ ] Photography/Art (17)
- [ ] Running/Jogging (18)
- [ ] Visiting beaches (19)
- [ ] Walking (20)
- [ ] Wildfowling (21)
- [ ] Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- [ ] Canoeing/ Kayaking /Rowing (23)
- [ ] Diving/Sub Aqua (24)
- [ ] Hover crafting (25)
- [ ] Jet Skiing (personal watercraft) (26)
- [ ] Kitesurfing/Windsurfing (27)
- [ ] Motor Boating/Power boating/Speed boating (28)
- [ ] Sailing/Cruising (yachting, dinghy sailing) (29)
- [ ] Water Skiing/Wake Boarding (30)
- [ ] Other (please specify) (31) _____

Display This Question:

If If What do you usually do when visiting coastal environment such as Morecambe Bay/the Essex Coast? (... q://QID239/SelectedChoicesCount Is Greater Than 1

Carry Forward Selected Choices from "tim_q1mor"

tim_q1bMor Which one of the selected activities, is the most common activity you practice when visiting coastal environment such as **Morecambe Bay**?

- Business (1)
- Entertainment (2)
- Dining (3)
- Visit friends / Relatives (4)
- Holiday / break (5)
- Birding (6)
- Cycling (7)
- Fishing/Angling (8)
- Golfing (9)
- Hang Gliding/Paragliding/Kite jumping (10)
- Horse Riding (11)
- Land Yachting (kite buggying, kite flying) (12)
- Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- Model Plane Flying/Micro lights (14)
- Natural History (15)
- Off Road Motoring (motorcycles, buggies and 4x4) (16)

- ○ Photography/Art (17)
- ○ Running/Jogging (18)
- ○ Visiting beaches (19)
- ○ Walking (20)
- ○ Wildfowling (21)
- ○ Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- ○ Canoeing/ Kayaking /Rowing (23)
- ○ Diving/Sub Aqua (24)
- ○ Hover crafting (25)
- ○ Jet Skiing (personal watercraft) (26)
- ○ Kitesurfing/Windsurfing (27)
- ○ Motor Boating/Power boating/Speed boating (28)
- ○ Sailing/Cruising (yachting, dinghy sailing) (29)
- ○ Water Skiing/Wake Boarding (30)
- ○ Other (please specify) (31) _____

tim_q2Mor Is the beauty of an area important when deciding where to undertake your preferred activity?

- ○ Yes (1)
- ○ No (0)

tim_q3Mor When you visit **Morecambe Bay**, what is your impression of the area's beauty? *Please select **ONE** answer per question depending on how strongly you agree/disagree with each statement:]*

	1 Strongly Disagree (1)	**2 Disagree** (2)	**3 Neither** (3)	**4 Agree** (4)	**5 Strongly Agree** (5)
The saltmarshes are beautiful (1)	○	○	○	○	○
The mudflats are beautiful (2)	○	○	○	○	○
Morecambe Bay is beautiful (3)	○	○	○	○	○

tim_q4Mor What groups of plants or animals **stand out to you** when undertaking your preferred activity *(Please tick all that apply)*

- [ ] Birds (© John Harding / BTO) (1)
- [ ] Fish (© Dezidor) (3)
- [ ] Saltmarsh Invertebrates (animals without a backbone - © CBESS) (5)
- [ ] Biofilm (microscopic plants and animals sticking together - © CBESS) (7)
- [ ] Large Animal (Excluding dogs and livestock - © Iain Smith) (2)
- [ ] Saltmarsh Plants (© CBESS) (4)
- [ ] Sediment Infauna (animals living in the sediment) (6)

Start of Block: Recreation Essex Coast

Q36 How many **trips** in total did you make to the **Essex Coast** within the last 12 months?

_____

Q37 Did any of these trips involve an overnight stay?

- Yes (1)
- No (0)

Display This Question:
If Q37 = 1

Q38 How many **days** in total did you spend in the **Essex Coast** area within the last 12 months?

_____

Q39 How many miles did you travel to get to the **Essex Coast** (one way distance)?

_____

Q40 How did you get there? (Tick all that apply).

- [ ] Car (1)
- [ ] Bus (2)
- [ ] Taxi (3)
- [ ] Walking (4)
- [ ] Bicycle (5)
- [ ] Motorbike (6)
- [ ] Other (please specify) (7) _____

Q41 Who did you travel with to the **Essex Coast** area? (Tick all that apply).

- ☐ Family (1)
- ☐ Friends (2)
- ☐ Partner (3)
- ☐ Co-workers (4)
- ☐ Group outing (5)
- ☐ I've travelled alone (7)
- ☐ Other (please specify) (6) _____

Q42 How much time (including your travel) did you spend on your last trip to the **Essex Coast** area? (Tick all that apply).

- ☐ Morning (1)
- ☐ Afternoon (2)
- ☐ Evening (3)
- ☐ All day (4)
- ☐ Overnight (5)
- ☐ More than one night (please specify how many) (6)

_____

Display This Question:

If Q42 = 6

Or Q37 = 1

Q43 When you stayed overnight, which type of accommodation did you use during your stay? (Tick all that apply).

- ☐ Hotel (1)
- ☐ Hostel (2)
- ☐ Campsite (Touring / Tent) (3)
- ☐ Campsite (Static) (4)
- ☐ Friends (5)
- ☐ Second Home (6)
- ☐ B&B (7)
- ☐ Family (8)
- ☐ Self Catering (9)

Display This Question:

If Q42 = 6

Or Q37 = 1

Q44 What was the cost of your accommodation per person per night?

- ○ £0 (1)
- ○ £1-£15 (2)
- ○ £16 - £30 (3)
- ○ £31 - £45 (4)
- ○ £46 - £60 (5)
- ○ £61 - £75 (6)
- ○ £76 - £90 (7)
- ○ £91 + (8)

Q45 **EXCLUDING ACCOMMODATION COSTS,** how much money did you spend during your last visit to the **Essex Coast**? (food, drink, transport costs, entrance fees, parking fees, activities etc).

- ○ £0 (1)
- ○ £1-£15 (2)
- ○ £16 - £30 (3)
- ○ £31 - £45 (4)
- ○ £46 - £60 (5)
- ○ £61 - £75 (6)
- ○ £76 - £90 (7)
- ○ £91 + (8)

Q46 How many days do you intend to spend in the **Essex Coast** area in the next 12 months?

_____

End of Block: Recreation Essex Coast

tim_q1
Ess What do you usually do when visiting coastal environment such as **the Essex Coast**? (Tick all that apply and select the most common).

- [ ] Business (1)
- [ ] Entertainment (2)
- [ ] Dining (3)
- [ ] Visit friends / Relatives (4)
- [ ] Holiday / break (5)
- [ ] Birding (6)
- [ ] Cycling (7)
- [ ] Fishing/Angling (8)
- [ ] Golfing (9)
- [ ] Hang Gliding/Paragliding/Kite jumping (10)
- [ ] Horse Riding (11)
- [ ] Land Yachting (kite buggying, kite flying) (12)
- [ ] Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- [ ] Model Plane Flying/Micro lights (14)
- [ ] Natural History (15)
- [ ] Off Road Motoring (motorcycles, buggies and 4x4) (16)

☐ Photography/Art (17)

☐ Running/Jogging (18)

☐ Visiting beaches (19)

☐ Walking (20)

☐ Wildfowling (21)

☐ Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)

☐ Canoeing/ Kayaking /Rowing (23)

☐ Diving/Sub Aqua (24)

☐ Hover crafting (25)

☐ Jet Skiing (personal watercraft) (26)

☐ Kitesurfing/Windsurfing (27)

☐ Motor Boating/Power boating/Speed boating (28)

☐ Sailing/Cruising (yachting, dinghy sailing) (29)

☐ Water Skiing/Wake Boarding (30)

☐ Other (please specify) (31) _____

Display This Question:

If If What do you usually do when visiting coastal environment such as Morecambe Bay/the Essex Coast? (... q://QID239/SelectedChoicesCount Is Greater Than 1

Carry Forward Selected Choices from "tim_q1Ess"

tim_q1bEss

Which one of the selected activities, is the most common activity you practice when visiting coastal environment such as **the Essex Coast**?

- ○ Business (1)
- ○ Entertainment (2)
- ○ Dining (3)
- ○ Visit friends / Relatives (4)
- ○ Holiday / break (5)
- ○ Birding (6)
- ○ Cycling (7)
- ○ Fishing/Angling (8)
- ○ Golfing (9)
- ○ Hang Gliding/Paragliding/Kite jumping (10)
- ○ Horse Riding (11)
- ○ Land Yachting (kite buggying, kite flying) (12)
- ○ Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- ○ Model Plane Flying/Micro lights (14)
- ○ Natural History (15)

- ○ Off Road Motoring (motorcycles, buggies and 4x4) (16)
- ○ Photography/Art (17)
- ○ Running/Jogging (18)
- ○ Visiting beaches (19)
- ○ Walking (20)
- ○ Wildfowling (21)
- ○ Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- ○ Canoeing/ Kayaking /Rowing (23)
- ○ Diving/Sub Aqua (24)
- ○ Hover crafting (25)
- ○ Jet Skiing (personal watercraft) (26)
- ○ Kitesurfing/Windsurfing (27)
- ○ Motor Boating/Power boating/Speed boating (28)
- ○ Sailing/Cruising (yachting, dinghy sailing) (29)
- ○ Water Skiing/Wake Boarding (30)
- ○ Other (please specify) (31) _____

tim_q2Ess Is the beauty of an area important when deciding where to undertake your preferred activity?

- ○ Yes (1)
- ○ No (0)

tim_q3Ess When you visit **the Essex Coast**, what is your impression of the area's beauty? *Please select **ONE** answer per question depending on how strongly you agree/disagree with each statement:]*

	1 Strongly Disagree (1)	**2 Disagree** (2)	**3 Neither** (3)	**4 Agree** (4)	**5 Strongly Agree** (5)
The saltmarshes are beautiful (1)	○	○	○	○	○
The mudflats are beautiful (2)	○	○	○	○	○
Essex Coast is beautiful (3)	○	○	○	○	○

tim_q4Ess What groups of plants or animals **stand out to you** when undertaking your preferred activity *(Please tick all that apply)*

- [ ] Birds (© John Harding / BTO) (1)
- [ ] Fish (© Dezidor) (3)
- [ ] Saltmarsh Invertebrates (animals without a backbone - © CBESS) (5)
- [ ] Biofilm (microscopic plants and animals sticking together - © CBESS) (7)
- [ ] Large Animal (Excluding dogs and livestock - © Iain Smith) (2)
- [ ] Saltmarsh Plants (© CBESS) (4)
- [ ] Sediment Infauna (animals living in the sediment) (6)

tim_q1both What do you usually do when visiting coastal environment such as **Morecambe Bay/the Essex Coast**? (Tick all that apply and select the most common).

- [ ] Business (1)
- [ ] Entertainment (2)
- [ ] Dining (3)
- [ ] Visit friends / Relatives (4)
- [ ] Holiday / break (5)
- [ ] Birding (6)
- [ ] Cycling (7)
- [ ] Fishing/Angling (8)
- [ ] Golfing (9)
- [ ] Hang Gliding/Paragliding/Kite jumping (10)
- [ ] Horse Riding (11)
- [ ] Land Yachting (kite buggying, kite flying) (12)
- [ ] Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- [ ] Model Plane Flying/Micro lights (14)
- [ ] Natural History (15)
- [ ] Off Road Motoring (motorcycles, buggies and 4x4) (16)
- [ ] Photography/Art (17)

- [ ] Running/Jogging (18)
- [ ] Visiting beaches (19)
- [ ] Walking (20)
- [ ] Wildfowling (21)
- [ ] Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- [ ] Canoeing/ Kayaking /Rowing (23)
- [ ] Diving/Sub Aqua (24)
- [ ] Hover crafting (25)
- [ ] Jet Skiing (personal watercraft) (26)
- [ ] Kitesurfing/Windsurfing (27)
- [ ] Motor Boating/Power boating/Speed boating (28)
- [ ] Sailing/Cruising (yachting, dinghy sailing) (29)
- [ ] Water Skiing/Wake Boarding (30)
- [ ] Other (please specify) (31) _____

Display This Question:

If If What do you usually do when visiting coastal environment such as Morecambe Bay/the Essex Coast? (... q://QID239/SelectedChoicesCount Is Greater Than 1

Carry Forward Selected Choices from "tim_q1both"

tim_q1bbot Which one of the selected activities, is the most common activity you practice when visiting coastal environment such as **Morecambe Bay/the Essex Coast**?

- ○ Business (1)
- ○ Entertainment (2)
- ○ Dining (3)
- ○ Visit friends / Relatives (4)
- ○ Holiday / break (5)
- ○ Birding (6)
- ○ Cycling (7)
- ○ Fishing/Angling (8)
- ○ Golfing (9)
- ○ Hang Gliding/Paragliding/Kite jumping (10)
- ○ Horse Riding (11)
- ○ Land Yachting (kite buggying, kite flying) (12)
- ○ Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- ○ Model Plane Flying/Micro lights (14)
- ○ Natural History (15)
- ○ Off Road Motoring (motorcycles, buggies and 4x4) (16)

- ○ Photography/Art (17)
- ○ Running/Jogging (18)
- ○ Visiting beaches (19)
- ○ Walking (20)
- ○ Wildfowling (21)
- ○ Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- ○ Canoeing/ Kayaking /Rowing (23)
- ○ Diving/Sub Aqua (24)
- ○ Hover crafting (25)
- ○ Jet Skiing (personal watercraft) (26)
- ○ Kitesurfing/Windsurfing (27)
- ○ Motor Boating/Power boating/Speed boating (28)
- ○ Sailing/Cruising (yachting, dinghy sailing) (29)
- ○ Water Skiing/Wake Boarding (30)
- ○ Other (please specify) (31) _____

Page Break

tim_q2both Is the beauty of an area important when deciding where to undertake your preferred activity?

- ○ Yes (1)
- ○ No (0)

tim_q3both When you visit **Morecambe Bay/the Essex Coast**, what is your impression of the area's beauty? *Please select **ONE** answer per question depending on how strongly you agree/disagree with each statement:]*

	1 Strongly Disagree (1)	**2 Disagree** (2)	**3 Neither** (3)	**4 Agree** (4)	**5 Strongly Agree** (5)
The saltmarshes are beautiful (1)	○	○	○	○	○
The mudflats are beautiful (2)	○	○	○	○	○
Morecambe Bay/Essex Coast is beautiful (3)	○	○	○	○	○

D16. What groups of plants or animals **stand out to you** when undertaking your **most common (pull the activity in the text)** activity *(Please tick all that apply)*

Birds  	Large Animals (excluding dogs and livestock) 
Fish  	Saltmarsh Plants 
Saltmarsh Invertebrates (animals without a backbone)  	Sediment Infauna (animals living in the sediment) 

Biofilm (microscopic plants and animals sticking together)

End of Block: Questions from TIM_both

Start of Block: from Wessex

wes1 With respect to your feelings about the plants and animals in coastal environment, please show your preference by choosing between the pairs of options.

	Strong preference	**Moderate preference**	**Slight preference**	**No preference**	**Slight preference**	**Moderate preference**	**Strong preference**	
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	
Complex coastal landscape	○	○	○	○	○	○	○	Flat coastal landscape
Coast carefully managed and neat	○	○	○	○	○	○	○	Coast that is left wild
Rare plants and animals	○	○	○	○	○	○	○	Common plants and animals
A wide variety of plants and animals	○	○	○	○	○	○	○	A lot of one or two particular plants and animals

Plants and animals I can easily see	○	○	○	○	○	○	○	Plants and animals I cannot easily see
Plants and animals I already know about	○	○	○	○	○	○	○	Plants and animals I do not know about yet

wes2 We would like to ask you about the type and importance of benefits that you get from the UK coastal environment and its wildlife

	Strongly Disagree (1)	**Disagree** (2)	**Neither Agree nor Disagree** (3)	**Agree** (4)	**Strongly Agree** (5)
The greater the range of plants and animals there is, the more I can learn and know (1)	○	○	○	○	○
Plants and animals in the countryside bring back treasured memories of childhood, family, friends and occasions (2)	○	○	○	○	○
I get no benefit from knowing more about nature (3)	○	○	○	○	○
Knowing about nature has no effect on the way I live and behave (4)	○	○	○	○	○
The greater the number and variety of plants and animals around me, the more I feel part of nature (5)	○	○	○	○	○
The natural world does not draw out spiritual feelings in me (6)	○	○	○	○	○
Being close to nature widens my understanding of life in general (7)	○	○	○	○	○
A wider range of plants and animals in a place encourages me to try new things (such as outdoor activities like walking, studying nature, painting, photography, activities with children, or 'inside' activities like watching nature films or reading) (8)	○	○	○	○	○
The greater the richness of nature in a place, the more I am inspired to be creative and use my imagination (such as being creative in photography, drawing, nature studies, games with friends or children) (9)	○	○	○	○	○
A richer mix of natural sights and sounds does little to stimulate my senses (10)	○	○	○	○	○
The more natural a place is, the more I can escape from the pressures of everyday life (11)	○	○	○	○	○
The tranquillity of natural places helps me calm down and relax (12)	○	○	○	○	○

The greater the abundance of nature in a place, the greater the sense of freedom I feel (13)	○	○	○	○	○
Visiting (or thinking about) places that are rich in wildlife helps to clear and refresh my mind (14)	○	○	○	○	○
When I visit the coast, the richer the wildlife, the more physically fit and energized my body feels (15)	○	○	○	○	○
The coastal environment tells me little about history and the past (16)	○	○	○	○	○
Visiting places that are rich in wildlife helps me to recover more quickly from illness or ill health (17)	○	○	○	○	○
I am sometimes frightened by creatures along the coast (18)	○	○	○	○	○
I rarely talk about nature and wildlife with workmates, friends, and family (including younger and older family members) (19)	○	○	○	○	○
I think a rich natural environment helps us all to get on much better with each other (20)	○	○	○	○	○
Looking after plants and animals in the coastal environment for the sake of our children and future generations is of little concern to me (21)	○	○	○	○	○
It makes me feel good to see the coast used for fishing and food production (22)	○	○	○	○	○
I am not really bothered about footpaths and tracks that allow me access to the coastal areas (23)	○	○	○	○	○
A loss of wildlife makes me feel less secure for the future (24)	○	○	○	○	○
I would feel less attached to the UK coastal environment if the plants and animals that live here disappeared (25)	○	○	○	○	○

End of Block: from Wessex

tim_q1NV What do you usually do when visiting coastal areas? (Tick all that apply and select the most common).

- [ ] Business (1)
- [ ] Entertainment (2)
- [ ] Dining (3)
- [ ] Visit friends / Relatives (4)
- [ ] Holiday / break (5)
- [ ] Birding (6)
- [ ] Cycling (7)
- [ ] Fishing/Angling (8)
- [ ] Golfing (9)
- [ ] Hang Gliding/Paragliding/Kite jumping (10)
- [ ] Horse Riding (11)
- [ ] Land Yachting (kite buggying, kite flying) (12)
- [ ] Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- [ ] Model Plane Flying/Micro lights (14)
- [ ] Natural History (15)
- [ ] Off Road Motoring (motorcycles, buggies and 4x4) (16)
- [ ] Photography/Art (17)

- [ ] Running/Jogging (18)
- [ ] Visiting beaches (19)
- [ ] Walking (20)
- [ ] Wildfowling (21)
- [ ] Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- [ ] Canoeing/ Kayaking /Rowing (23)
- [ ] Diving/Sub Aqua (24)
- [ ] Hover crafting (25)
- [ ] Jet Skiing (personal watercraft) (26)
- [ ] Kitesurfing/Windsurfing (27)
- [ ] Motor Boating/Power boating/Speed boating (28)
- [ ] Sailing/Cruising (yachting, dinghy sailing) (29)
- [ ] Water Skiing/Wake Boarding (30)
- [ ] Other (please specify) (31) _____

Page Break

Display This Question:

If If What do you usually do when visiting coastal areas? (Tick all that apply and select the most comm... q://QID253/SelectedChoicesCount Is Greater Than 1

Carry Forward Selected Choices from "tim_q1NV"

tim_q1bNV Which one of the selected activities, is the most common activity you practice when visiting coastal areas?

- Business (1)
- Entertainment (2)
- Dining (3)
- Visit friends / Relatives (4)
- Holiday / break (5)
- Birding (6)
- Cycling (7)
- Fishing/Angling (8)
- Golfing (9)
- Hang Gliding/Paragliding/Kite jumping (10)
- Horse Riding (11)
- Land Yachting (kite buggying, kite flying) (12)
- Marine Interpretation Tours (Boat trips, wildlife tours, cross bay walks) (13)
- Model Plane Flying/Micro lights (14)
- Natural History (15)
- Off Road Motoring (motorcycles, buggies and 4x4) (16)

- ○ Photography/Art (17)
- ○ Running/Jogging (18)
- ○ Visiting beaches (19)
- ○ Walking (20)
- ○ Wildfowling (21)
- ○ Board Surfing/Surfboarding/Paddle boarding/ Body boarding (22)
- ○ Canoeing/ Kayaking /Rowing (23)
- ○ Diving/Sub Aqua (24)
- ○ Hover crafting (25)
- ○ Jet Skiing (personal watercraft) (26)
- ○ Kitesurfing/Windsurfing (27)
- ○ Motor Boating/Power boating/Speed boating (28)
- ○ Sailing/Cruising (yachting, dinghy sailing) (29)
- ○ Water Skiing/Wake Boarding (30)
- ○ Other (please specify) (31) _____

tim_q2NV Is the beauty of an area important when deciding where to undertake your preferred activity?

- ○ Yes (1)
- ○ No (0)

tim_q3NV When you visit a coastal area, what is your impression of the area's beauty? *Please select **ONE** answer per question depending on how strongly you agree/disagree with each statement:]*

	1 Strongly Disagree (1)	**2 Disagree** (2)	**3 Neither** (3)	**4 Agree** (4)	**5 Strongly Agree** (5)
The saltmarshes are beautiful (1)	○	○	○	○	○
The mudflats are beautiful (2)	○	○	○	○	○
The UK coast is beautiful (3)	○	○	○	○	○

D16. What groups of plants or animals **stand out to you** when undertaking your **most common (pull the activity in the text)** activity *(Please tick all that apply)*

Birds  	Large Animals (excluding dogs and livestock) 
Fish  	Saltmarsh Plants 
Saltmarsh Invertebrates (animals without a backbone)  	Sediment Infauna (animals living in the sediment) 

Biofilm (microscopic plants and animals sticking together)

End of Block: Questions from TIM_both

Start of Block: Final questions

Q124a Are you a member of an Environmental Organisation (such as the National Trust, Friends of the Earth, RSPB, Marine Conservation Society, Woodland Trust etc)?

- Yes (1)
- No (0)

Display This Question:

If Q124a = 1

Q124 Please specify which Environmental Organisation (such as the National Trust, Friends of the Earth, RSPB, Marine Conservation Society, Woodland Trust etc) you are a member of:

_____

_____

_____

_____

_____

Q14 **How many people live in your household excluding you?**

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 or more (5)

Q16 **How many children (below 16) live in your household?**

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 or more (5)

Q18 **What is your highest academic attainment?**

- ○ Primary school only (1)
- ○ GCSE (2)
- ○ A-level (3)
- ○ College (such as NVQ) (4)
- ○ University degree or higher (5)

Q20
Which of the following categories best describes your annual household income before taxes (whether from employment, state benefits, investment or any other source)? *This information is important for statistical purposes and will be kept confidential.*

- ○ less than £10,000 (1)
- ○ £10,000 to £30,000 (2)
- ○ £30,001 to £60,000 (3)
- ○ more than £60,000 (4)

End of Block: Final questions

Start of Block: Debrief

Q18
Debrief
Thank you for taking part in the study, please click "Submit" to finish the survey and record your answers.

The choices you selected will be confidential and will not be traceable to any individual by name. The data collected will only be used by the researchers who are analysing the data. By participating in the study you are helping researchers understand the value of **Morecambe Bay, the Essex Coast** and more generally of the UK Coastal biodiversity.

Your data will be kept confidential and anonymous. If you have any further questions or queries please do not hesitate to contact the principal investigator [redacted]

End of Block: Debrief

Appendix B

Analytic framework: modelling data from discrete choice experiments and preference analysis

Analysis of DCE data is based on the random utility maximisation (RUM) theory (Thurstone, 1927; Manski, 1977) where the underlying assumption is that individuals select the alternative that offers them the highest utility (U) defined as:

$$U_{nit} = \beta' X_{nit} + \varepsilon_{nit} , \qquad (1)$$

where β is the vector of parameters to be estimated, *X* is the vector of attributes and levels describing the alternative management scenario (each considered as a categorical variable, either as an increase or decrease relative to the current situation), and ε represents the part of the utility function that the researcher cannot observe and is represented as an independent and identically Gumbel distributed error term. With these definitions and assumptions it is possible to mathematically model the choice probability for each respondent *n* selecting management option *i* over *j* alternatives observed in choice task *t*, as a Multinomial Logit (MNL) probability function (McFadden, 1974):

$$\Pr(nit) = \frac{\exp(\beta' X_{nit})}{\sum_{j=1}^{J} \exp(\beta' X_{njt})} . \qquad (2)$$

This model is estimated as a starting point in our analysis for its econometric properties and practical implications. However, the MNL specification assumes that preferences are homogenous across respondents and that choices are independent of irrelevant alternatives (IIA). These assumptions are often considered unrealistic and likely to bias results. The mixed logit (MXL) model relaxes the strong assumptions underlying the MNL model and accommodates the fact that different respondents may have different preferences (McFadden and Train, 2000).

As we were interested in understanding if it was possible to cluster the population based on their preferences for biodiversity in coastal areas, the Latent Class (LC) model, a semi-parametric variant of the MXL model, was employed. In LC models, the researcher assumes that each respondent can be probabilistically sorted into a set of C classes defined by different sets of preferences embedded in the utility parameters, β_c. Defining the membership probabilities π for each latent class *c* according to a MNL process, we have:

$$\pi_c = \frac{\exp(\alpha_c + \gamma_c z_n)}{\sum_{c=1}^{C} \exp(\alpha_c + \gamma_c z_n)} , \qquad (3)$$

where z_n is a vector of covariates characterizing respondent *n*, and γ_c is the vector of associated parameters subject to estimation, while αc is a class-specific constant. In order to identify the best vector z_n to describe the distribution of respondents across classes, we firstly considered all the information collected within the survey about the respondents (reported in Table 1). We considered marital status, employment status, level of education achieved, income and gender as categorical variables, and number of dependent children in the household, number of people in the household and age (and age squared, to allow for non-linearity), as continuous variables. Since we were interested in understanding the link between use of the coast and birds and the associated value, we also included whether the respondent had visited the coast in the last 12 months or not and the membership of

environmental organizations. Some of these factors (marital status, employment status, level of education achieved, number of dependent children in the household, number of people in the household) were not included in the final model following the approach highlighted below (Bayesian and Akaike information criteria).

The membership probability defined in Equation 3 allows us to characterise the type of respondents in the sample more likely to be associated with a specific set of preferences (β_c). In estimation, for identification purposes only C-1 set of coefficients can be independently identified, while for one arbitrary class c the vector < αc : γ_c> is constrained to zero. The probability of a sequence of choices y_{Tn} over T choice occasions for respondent *n* is therefore defined as:

$$P(y_n|\beta_c,X_{nit}) = \sum_{c=1}^{C}\pi_c\prod_{t=1}^{T}\frac{\exp(\beta_c^{'}X_{nit})}{\sum_{j=1}^{J}\exp(\beta_c^{'}X_{njt})} \quad . \qquad (4)$$

However, in this study, coefficients in the class membership probability are effect-coded. It is therefore possible to estimate coefficients for C-1 classes and retrieve (as the negative sum of the non-omitted classes) the coefficients for the omitted class. From Eq. 4 it is possible to retrieve the likelihood function (L) to be maximised in our estimations as:

$$\mathrm{L} = \prod_{n=1}^{N}\left[\sum_{c=1}^{C}\pi_c\prod_{t=1}^{T}\frac{\exp(\beta_c^{'}X_{nit})}{\sum_{j=1}^{J}\exp(\beta_c^{'}X_{njt})}\right] , \quad (5)$$

where the alternative *i* is the selected option in the choice task *t* among all other alternatives *j* by individual *n* among N respondents in the sample.

The first and one of the most important steps when considering a LC analysis is to define the optimal number of classes for the data. As suggested in the literature, information criteria should be used based on the log-likelihood of the model and penalized for the number of parameters to be estimated. More specifically we looked at the Bayesian information criteria (BIC – Hurvich and Tsai, 1989), the Akaike information criteria (AIC – McLachlan & Peel, 2000) and the AIC3, a variation of the AIC that penalizes more for the number of parameters used in estimation (Wedel and Kamakura, 2000). However, as noted by Leroux (1992) and also reported and reinforced in Thiene *et al.* (2013), these criteria fail some of the regularity conditions for a valid test under the null hypothesis. Furthermore, only looking at AIC and BIC often results in optimal models with a high number of classes, not always supported by the data as the precision of the single parameter estimates of each class decreases (e.g. it is associated with higher standard errors) as the number of classes increases. As noted by Thiene *et al.* (2013) a consequence of this is that the selection of number of classes to be included in the model often implies value judgments about the overall significance and meaningfulness of parameter estimates, their signs and the overall model fit. In this study, following Thiene *et al.* (2013), the information criteria were evaluated and then plotted in order to understand the number of classes at which convergence is achieved; for our dataset convergence occurred at four classes.

Once the MNL (Eq. 2) and the LC (Eq. 5) are estimated, it is interesting to use model estimates to gather an understanding on how much each attribute can marginally contribute to respondents' welfare. Indeed, one possible approach to understand the benefit that respondents would get for different levels of improvements for the different measures of

biodiversity presented in the DCE is given by the implicit prices for each attribute. These are generally referred to as marginal willingness to pay (WTP) and computed as the negative ratio between the coefficient for each attribute (at numerator) and the cost coefficient (at denominator). These measures highlight the trade-offs that people are willing to make between a given improvement in any measure of birds' biodiversity and the amount of money donated. In our results we present WTP estimates, significance level and 95% confidence intervals (C.I.) for both MNL and LC models.

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